Report of the State Comptroller of Israel |
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Israel Electric Company Ltd.

Preservation and Conversion of Coal-Fired Power Plants

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Background

In recent years, the Israeli government and the Ministry of Energy have decided to reduce the use of coal for electricity production, among other things, to reduce the air pollution emitted and to meet government goals following international agreements to reduce greenhouse gas emissions. Ten coal-fired power units operate in the electricity sector, all owned and operated by the Israel Electric Company Ltd. (IEC). In 2019, the Minister of Energy decided to convert six coal-fired units, where devices to reduce emissions (scrubbers) were installed, to natural gas-fired power plant. In 2021, the Minister of Energy decided to preserve four coal-fired units, in which no scrubbers were installed, as market insurance for an emergency year, this after the cessation of their current operations in 2022, depending on the fulfillment of the conditions[1] defined in Government Resolution 4080.

1 Government Resolution 4080 resolved to cease the current operations of units 1–4 at the Orot Rabin Station no later than June 1, 2022, provided that the following conditions are met cumulatively by the said date: (a) There will be a surplus in the supply of natural gas to the market in Israel through the connection of three natural gas reservoirs, each of which will be connected to the national natural gas transmission system via a separate infrastructure; (b) Start of operation of the first combined cycle power plant with a capacity of about 600 megawatts which will be established at the Orot Rabin Station by June 1, 2022.

Key Figures

10 coal units

six of which are to undergo conversion to natural gas, and four of which are to enter preservation in 2022

35%

the decreased rate of electricity production using coal from 2015 to 2020 due, among other things, to the Ministry of Energy's reduction policy

NIS 1.4 billion

the net excess cost (in present values) of the preservation project according to Electricity Authority. Including external costs of the project, this cost increased to NIS 2.7 billion, and it may rise to NIS 4.3 billion costs if increased periodic operations and lower scrapping costs would be included

NIS 124 million

the annual cost (in present values) of the preservation project, including operating, employee costs, fuel and air pollution damage costs

1,440 MW

the capacity of units 1–4 at the Orot Rabin plant, operating without scrubbers, that are to enter preservation in 2022

3,400 MW

the capacity of six coal-fired units that are to be converted to gas in 2022–2026

NIS 1.3 billion

the net excess cost (in present values) of the conversion project of the coal units with installed scrubbers

NIS 1.6 billion

the possible savings (in present values) from the seasonal operation of the converted units until 2045

Audit Actions

From March to December 2021, the State Comptroller's Office examined the Ministry of Energy's decision-making process to preserve and converge coal-fired power plants to natural gas, the calculations performed, and the alternatives considered as the basis of these decisions. The audit was conducted at the Ministry of Energy, the Electricity Authority (the Authority), the IEC, and the Ministry of Environmental Protection. Completion examinations were conducted at Noga – the Israel Independent System Operator Ltd. company.

Key Findings

- **The Uniqueness of the Preservation of Units' 1–4 Project** – the preservation of coal-fired power units in the IEC outline has not been attempted in any other country. Most of the countries reviewed by the Authority are scrapping the coal-fired plants, and countries with low energy security continue to operate them.

- **Estimates of the Scrapping Cost of Units 1–4 in the Preservation Document** – despite the adjustments made by the Authority to IEC's scrapping cost estimate (which reduced the scrapping cost estimate from NIS 687 million to NIS 506 million), the scrapping cost noted in the preservation document is twice the corresponding costs in the Authority's review. The Authority's review presents a lower scrapping cost of NIS 200 to 270 million. (instead of the scrapping cost considered in the amount of NIS 506 million) This increases the preservation project alternative excess costs by about NIS 66 to 85 million (an increase of about 5% to 6% of the excess cost of the preservation project). Additionally, presenting scrapping costs higher than those accepted worldwide increases the cost estimate of the scrapping alternative and the viability of the preservation alternative.

- **The Potential Deviation of the Cost of the Preservation Project due to Periodic Activations** – between the preservation draft and the preservation document, IEC updated its assessment regarding the number and duration of the periodic activations required for the preservation of the units. According to the State Comptroller's Office estimate, this update is estimated at NIS 1.5 billion. It was found that the Electricity Authority presented the excess costs of the preservation alternative at about NIS 631 million according to the Company's minimal estimate regarding the periodic operations as included in the last preservation document. Presenting minimal costs may cause underestimated actual preservation project excess cost, in particular, given the

considerable uncertainty in the preservation project, due, among other things, to the lack of international and Company experience in similar projects and as an accurate assessment of the periodic activations will only be possible after an actual examination of the preservation outline.

- **Updating the External Costs of the Preservation of Units 1–4 in an Emergency Year** – the Authority did not update in the preservation document the external costs of the damage of local pollutant emissions and greenhouse gases in an emergency year, and did not include the external costs from the damage of greenhouse gas emissions in the total preservation project excess cost. This bias in favor of the preservation project indicates benefit from the preservation alternative in an emergency year, but in practice, this alternative resulted in excess cost after updating the cost values. The failure to update the aforementioned external costs resulted in an underestimation of the preservation project, at NIS 709 million, and the exclusion of the external costs of greenhouse gases resulted in a devaluation of NIS 522 million, and in total, the excess cost of the preservation project in an emergency year was underestimated by about NIS 1.2 billion.

- **Priority for Emergency Power Generation from Units 70–80 over Units 1–4** – supplying electricity from units 70 – 80 and units 1 – 4 at the Orot Rabin Station simultaneously is impossible, and therefore there is substitution option between units 70 – 80 powered by diesel fuel and units 1 – 4 powered by coal. The difficulty in transporting diesel fuel for electricity during an emergency emphasizes this substitutability because as long as it is not possible to transfer diesel fuel to sites other than the Orot Rabin plant – which has both primary diesel fuel reserve and a diesel fueling infrastructure – this reserve will most likely be used to generate electricity using units 70–80. Therefore, preserving units 1–4 for emergencies will not increase electricity generation at the economic level since units 70–80 are new and more efficient than units 1–4, at which case there is a priority in operating them over units 1–4.

- **The Feasibility of Using Units 1–4 as a Response to Electricity Shortage During an Emergency** – given the preservation of units 1–4 is not carried out simultaneously, and its completion coincides with most of the period of the emergency event defined in the reference scenario, and given the difference between the Company's estimates regarding the preservation time, the ability to use units 1–4 during an emergency is uncertain. In case the emergency event materializes in a later year, the uncertainty regarding the ability to return from preservation will increase since the lack of continuous operation of the units regularly will reduce the units' serviceability and require more significant maintenance.

- **Joint Personnel for the Operation of Units 1–4 and 70–80** – the reliance on joint personnel for the operation of units 70–80 and 1–4, and the need to divert workers from units 70–80 to 1–4 for their return from preservation, may affect the regular operation of units 70–80 during an emergency and the electricity supply from these units

until the return of units 1–4 to regular and continuous operation. The diversion of workers from units 70–80 to the preserved units 1–4 and its implications may increase the cost estimate of the preservation project.

- **The Uncertainty in Preserved Units 1–4** – the differences between the preservation document from 2016 and the one from 2020 and the change in the Company preservation plan raise doubts over the ability to preserve units 1–4. The new IEC preservation plan in 2020 was not based on technological progress over time, and it is similar to the model of shutting down the units for maintenance for a few months and bringing them back into operation, as is done from time to time. Furthermore, although the preservation project is to ensure coal production capacity as a backup for natural gas in an emergency year, by the Authority and Company's preservation documents, there are no preservation projects in the current outline. The Company has no experience preserving coal-fired power plants for quick operation in an emergency. Moreover, the preservation project is complex and fraught with risks, among other things, as units 1–4 are old and require much maintenance. This may impair the ability to rely on continuous and reliable electricity production from these units during an emergency.

- **Considering the Electricity Demand Decrease in an Emergency Year for Calculating the Damage Estimate to the Economy from Scrapping Units 1–4** – the IEC estimate of the expected damage to the economy in an emergency year due to the scrapping of units 1–4 in NIS 20 billion did consider the research literature and experience of changes in electricity demand during times of crisis. By the State Comptroller's Office calculation, given the electricity demand behavior in past events and according to the research literature, in the emergency scenario on which the Authority based the preservation document, and on which the IEC formed its opinion and estimated the extent of the unsupplied energy for the emergency year without the preservation of units 1–4, the decrease in emergency demand, which may reach up to 11%, was not considered.

- **The Operating Regime of the Converted Units** – the efficiency of the coal-fired units, both before and after the conversion, is low relatively to the natural gas production units in the electricity sector. According to IEC estimates, the efficiency of the converted units will be about 38%, compared to the average efficiency of existing gas production units, which is about 46%. Due to operational constraints, the coal-fired units must work at a minimal load, i.e., an operating regime called Must Run. Given the efficiency of the converted units is low compared to the market average, and therefore they are more polluting and more expensive, so if preservation takes a short time, it will be possible to have a seasonal operation of the converted units saving both air pollution costs and fuel costs. Seasonal operation of the converted units from 2026 and up to 2045 (according to a conservative assumption that their operation will not be required for four months each year) may save about NIS 1.1 billion in fuel costs and external costs from emitting local pollutants. In addition, seasonal operation of the converted units may save an additional external cost regarding greenhouse gas emissions of about NIS half a billion.

Therefore, seasonal operation of the converted units from 2026 to 2045 may save costs in about NIS 1.6 billion (present value for 2019).

The Economic Viability of the Alternative of Converting Coal Units to Natural Gas – it was found that the investment required in the conversion alternative (about NIS 1.2 billion) is relatively low from the cost of establishing new capacity (a difference of about NIS 7.5 billion). It was also found that the cost of fuel in the conversion alternative (about NIS 2 billion) is higher than the cost of fuel in the preservation and establishment alternative (savings of about NIS 3.3 billion compared to the base alternative), or in the scrapping and establishment alternative (savings of about NIS 3.4 billion compared to the base alternative), due to the low efficiency of the converted units. However, this difference (for NIS 5.4 billion) is lower than the difference in the required investment cost, and therefore there is economic viability for the conversion project.

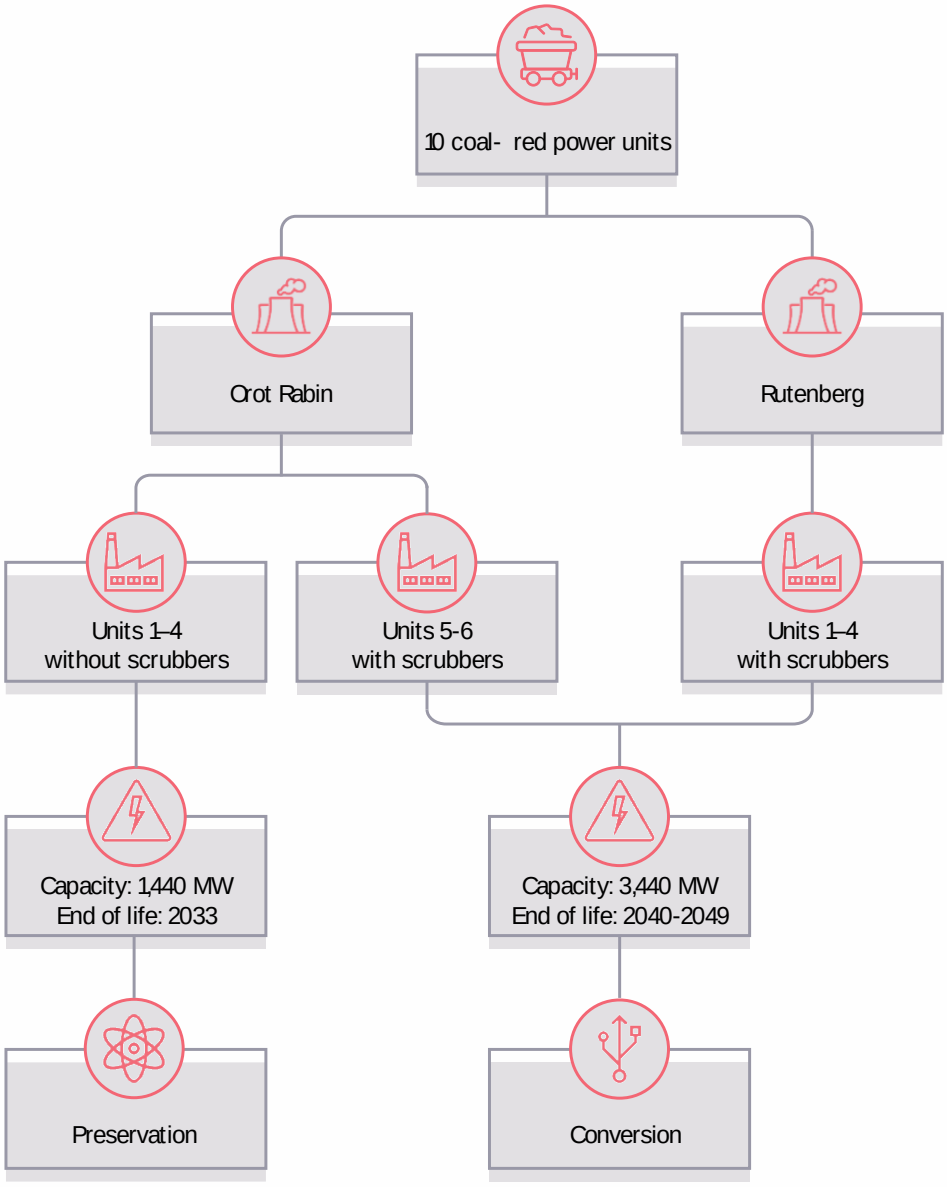
Key Recommendations

- It is recommended that the Ministry of Energy and the Authority examine annually the need to preserve units 1–4 and the feasibility of their continued preservation, and scrap them according to the feasibility examination, subject to maintaining the guarantee of power supply during routine and emergency times and promoting the alternatives for generating power in these units as soon as possible.
- Given the difference between the IEC scrapping cost and the actual costs in the United States it is recommended (a difference of NIS 417–487 million), that the Authority examine the cost structure of the preservation project and include them in the cost control of the project. It is further recommended that the Authority examine the costs derived from the first actual operation of the preserved units 1–4 and update its calculations, and present it jointly with Ministry of energy to the minister of Energy.
- It is recommended that IEC and the Authority examine the number of workers needed to preserve units 1–4 without affecting the competency of units 70–80, calculate their cost and include it in the preservation costs. It is also recommended to examine the outline of the preserved 1–4 units while emphasizing the use of joint personnel from units 70–80 and 5–6 and considering the uncertainty regarding the timing and duration of return from preservation in an emergency.
- It is recommended that the Ministry of Energy, the Authority, and the IEC examine the preservation project and its implications, given its excess costs, inherent risks, and existing alternatives, such as diesel generation in units 70–80 at the Orot Rabin plant.

- Given the potential savings in fuel costs and external costs from air pollution, and according to the difference between the capital cost of preserving units 1–4 for 12 years, at about NIS 162 million according to the IEC estimate, this compared to possible savings from seasonal operation in about NIS 1.6 billion (for approximately 20 years), considering the need to minimize costs under Section 1 of the Electricity Sector Law, 1996, it is recommended that the Authority and the Israel Independent System Operator company perform a cost-benefit analysis of the seasonal operation of the converted units and accordingly consider the possibility of seasonal operation of the converted units instead of continuous operation in the Must Run regime, considering operational constraints and the forecasted electricity demand.

- Alongside the selection of the conversion alternative currently, it is recommended that the Authority and the Ministry of Energy examine over the years the technological developments in energy storage and remove the barriers to increase production through renewable energies and promote technological solutions enabling production with renewable energies with a smaller backup of fossil fuels and accordingly examine the need to continue implementing the conversion alternative.

The Characteristics and Purpose of the Coal-Fire Powered Units in the Electricity Sector



According to the Electricity Authority data processed by the State Comptroller's Office.

Summary

In recent years, the Israeli government and the Ministry of Energy policy have been to reduce the use of coal for electricity generation, among other things, to reduce air pollution and greenhouse gas emissions. The Minister of Energy's decision to preserve units 1−4 as emergency market insurance involves an excess cost that may reach up to NIS 4.3 billion. However, the inherent risks and the uncertainty regarding the return to use of the preserved units raise doubts over the project's ability to provide market insurance. This project also constitutes a complete alternative for electricity production in the new, efficient, and less polluting units 70−80, and in an emergency, the production in units 1−4 will be at their expense. Alongside the preservation project, the Minister of Energy decided to convert the coal units (those not intended for preservation). This project has economic viability and serves as the best alternative to stop the use of coal, as long as technological limitations require backup capacity with conventional installed capacity for electricity generation with renewable energies. However, there is a potential for substantial savings from the seasonal operation of the converted units instead of permanent operation at minimal load (Must Run).